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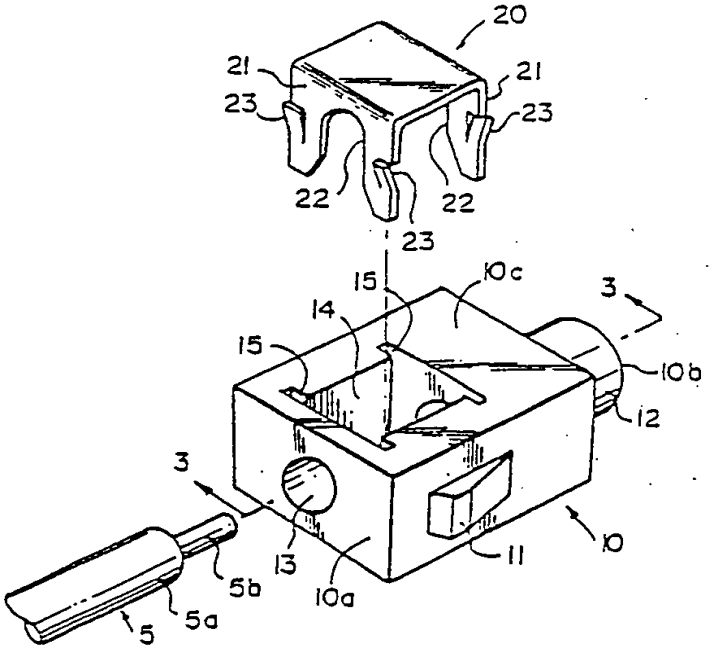
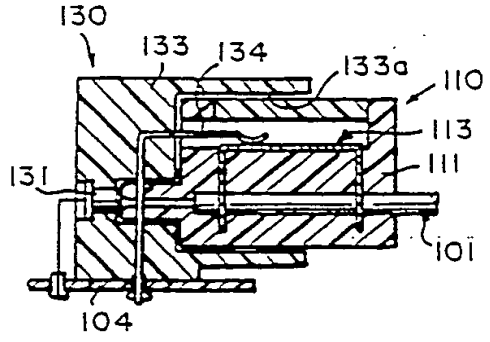
(57) Abstract

An optical fiber connector comprises a retaining plate (20, 60, 85, 95, 113, 142, 173) made of comparatively thin sheet metal and having a slot (22, 61, 86, 113a, 173a) formed therein which has an opening at one end, the opening having a width smaller than an outer diameter of an optical fiber jacket (5a, 101b, 103a) and larger than a diameter of a fiber optic core (5b, 101a, 103d). The retaining plate is inserted in a connector body (10, 70, 80, 90, 111, 141, 171) at almost a right angle to an axial direction of the optical fiber cable (5, 101, 103) disposed in the connector body with the opening of the slot facing toward the optical fiber cable, and the retaining plate is pressed into the connector body and the jacket of the original fiber cable in the connector body.





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OPTICAL FIBER CONNECTOR

This invention is related to an optical fiber connector which is used for connecting optical fibers for transmitting light signals between photo transmitters and receivers. The connector is also used for connecting electrical wires for transmitting power to another connector.

Optical fiber cables used for signal transmission are composed of a linear core formed of optical glass or plastic, and a jacket made of a resin such as urethane, polyethylene, or vinyl covering the outer surface of the glass or plastic core. Such cables are used in various fields such as optical communication.

When transmitting light signals by an optical fiber cable, the photo signal is transferred by disposing the end portion of the optical fiber to the transmitter or receiver for receiving light signals to the end of another optical fiber to which it is connected and the signal is transferred between the ends of these optical fibers. For the connection mentioned above, various types of optical connectors have been disclosed. For example, the connector disclosed in Unexamined Japanese patent application No. 58-174916, the end portion of an optical fiber cable which is inserted inside the connector housing is clamped by a fastening member which is press-fitted between the connector housing and the optical fiber cable, and thus the optical fiber cable is firmly retained in the connector housing. Namely, the fastening member retains the end portion of the optical fiber cable inside the connector housing by clamping, and a firm fixation of the optical fiber cable is created by the clamping force.

However, when using these connectors, a problem arises wherein the optical fiber cable can be pulled out if the clamping force of the fastening member is weak, and conversely, if the clamping force is too strong, a loss of the light signal during transmission may occur because the fiber optic core is compressed and deformed by this clamping force if the fiber

optic core is made of plastic. Further, where a fixed retention by this clamping force is obtained by the elastic deformation of the jacket, the elastically deformed portion is permanently deformed according to the condition and period of use of the optical fiber cable, and then a problem arises in that the optical fiber cable is liable to come loose from the connector, since the elasticity decreases and thus the clamping force is also decreased. Further, it is known to apply an adhesive to retain the end portion of the optical fiber cable in the connector thereby securing the optical fiber cable to the connector. This practice is inconvenient and it is difficult to use for automated manufacturing.

In consideration of the fore-mentioned problems, the object of this invention is to provide a connector that does not compress the fiber optic core of an optical fiber cable, but firmly and securely retains the end portion of the optical fiber cable in the connector, and further, to provide a connector with a simplified structure in which the optical fiber cable is easily and firmly retained in position in the connector with no loss of light transmission of the fiber optic core.

Another object of this invention is the provision of a connector that also electrically connects with and retains an electrical wire in the connector.

The optical fiber connector of this invention is characterized in that a retaining plate is made of comparatively thin sheet metal and having a slot formed therein which has an opening at one end, the opening having a width smaller than an outer diameter of an optical fiber jacket and larger than a diameter of a fiber optic core. The retaining plate is inserted in a connector body at almost a right angle to an axial direction of the optical fiber cable disposed in the connector body with the opening of the slot facing toward the optical fiber cable, and the retaining plate is pressed into the connector body and the jacket of the original fiber cable in the connector body.

The optical fiber connector is also characterized by having a photoelectronic element receiving cavity at the opposite end where the end portion of an optical fiber cable is inserted into the connector body, and after positioning the end of the optical fiber cable against the photoelectronic element which is fixed in the receiving cavity, inserting the slotted retaining plate into the connector body at almost a right angle to an axial direction of the optical fiber cable with the opening of the slot facing toward the optical fiber cable, then pressing the slotted retaining plate into the jacket of optical fiber cable to firmly retain the end of the optical fiber cable in the connector body.

Further, the optical fiber connector is characterized by a passageway which extends from one end to the opposite end of the connector body, and the end portions of a pair of optical fiber cables are inserted into the passageway so that the end faces of the optical fiber cables are engaged at the middle of the passageway, then the slotted retaining plates are inserted respectively into the connector body at almost a right angle to an axial direction of the optical fiber cables with the opening of the slot facing toward the optical fiber cables, the retaining plate is then pressed into the jacket of each optical fiber cable to firmly retain the end portions of both optical fiber cables in the connector body.

The hybrid optical-electrical connector of this invention comprises a connector housing having holes wherein end portions of an optical fiber cable and a wire are inserted, and the end portions of the optical fiber cable and of the wire are engaged by a contact and retaining plate made of a conductive material and fitted inside the connector housing. The contact plate retains the end portions of the optical fiber cable and the wire, and is also connected with the conductor of the wire in the connector housing. When the hybrid optical-electrical connector is engaged and connected with a matable connector, an electrical contact of the matable connector is electrically connected with the contact plate.

A brief description of the drawings of the invention is set forth by way of example according to the following:

Figure 1 is a perspective view of the optical fiber connector according to this invention.

Figure 2 is a perspective exploded view of the plug connector as an optical fiber connector according to this invention.

Figures 3A to 3C are cross-sectional views taken along line III-III of Figure 2 showing an assembly of the plug connector.

Figures 4A to 4C are cross-sectional views taken along line IV-IV of Figure 3A showing an assembly of the plug connector.

Figures 5 and 6 are perspective exploded views showing different embodiments of the optical fiber connector according to this invention.

Figure 7 is an exploded perspective view of a further embodiment according to this invention.

Figure 8 is a cross-sectional view taken along line VIII-VIII of Figure 7.

Figure 9 is an exploded perspective view of an additional embodiment according to this invention.

Figure 10 is a cross-sectional view taken along line X-X of Figure 9.

Figure 11 is a perspective exploded view of a still further embodiment of the invention showing a hybrid optical-electrical connector member and the matable connector member.

Figure 12 is a cross-sectional view of the hybrid optical-electrical connector member of Figure 11.

Figures 13A and 13B are respective perspective exploded and perspective views of only the optical fiber cable, the wire, and the contact and retaining plate.

Figures 14 and 15 are cross-sectional views showing the hybrid optical-electrical connector member connected with the matable connector member.

Figure 16 is a perspective exploded view of another embodiment of the invention showing a hybrid optical-electrical connector member together with the matable connector member.

Figure 17 is a cross-sectional view showing both connector members of Figure 16 connected.

Figure 18 is a cross-sectional view of an additional embodiment showing hybrid optical-electrical connectors of this invention connected within a housing.

Figures 19A and 19B are respective perspective exploded and perspective views showing the engagement of the hybrid optical-electrical cable, which is integrally composed of the optical fiber and the wire, and the contact and retaining plate.

Figures 20A and 20B are cross-sectional views corresponding to Figures 19A and 19B.

Figure 21 is a perspective exploded view showing the hybrid optical-electrical connector member together with the matable connector member using the cable shown in Figures 19A to 20B.

Figure 22 is a schematic circuit diagram of a system which conducts an information transfer by light signals by using the hybrid optical-electrical connector member of the present invention.

The following is a description of the preferred embodiments of this invention by way of example with reference to the drawings.

Figure 1 is a perspective view showing the connector assembly of the optical fiber connector which is composed of a plug connector 1 wherein an end portion of an optical fiber cable 5 is secured, and a receptacle connector 3 wherein a photoelectronic element 6 is secured. The plug connector 1 is an optical fiber connector according to an embodiment of this invention and is composed of a connector body 10 and a retaining plate 20. An end portion of an optical fiber cable 5 is inserted into the connector body 10 and is firmly retained therein by the retaining plate 20.

At this stage, a fiber optic core 5b is inserted in connector body 10 to the end face of a cylindrical portion 12 of the connector body 10. Cylindrical portion 12 acts as a ferrule for the connector. The receptacle connector 3 has a cylindrical bore 32 which extends therethrough from the back to the front thereof, and at the front portion thereof, connector 3 has latching arms 31 which engage with engaging projections 11 of the connector body 10. A photoelectronic element 6 is secured in the rear end of cylindrical bore 32. This photoelectronic element 6, such as a light emitting diode or a photodiode, generates light signals to the optical fiber core. Photoelectronic element 6 can also be a photodetector. To connect the plug connector 1 with the receptacle connector 3, the cylindrical portion 12 is inserted into the cylindrical bore 32, latching arms 31 engage projections 11 and accordingly, the end face of the fiber optic core 5b is brought adjacent to or in contact with the outer face of the cylindrical portion 12, and opposite to the photoelectronic element 6.

Figure 2 shows details of the above-mentioned plug connector 1, and Figures 3A to 3C show a method of mounting the optical fiber cable 5 in the plug connector 1. Further, Figures 4A to 4C show a method of mounting the optical fiber cable 5 corresponding to Figures 3A and 3G.

The connector body 10 has a bore 13 extending from the rear end face 10a to the front face 10b of cylindrical portion 12. Bore 13 includes a rear section 13a having a diameter slightly larger than the outer diameter of the jacket of the optical fiber cable 5, and a front section 13b having a diameter slightly larger than the diameter of the fiber optic core 5b. Furthermore, the connector body 10 has an aperture 14 formed from an upper face 10c and in communication with the section 13a. At the back and front of this aperture 14, a pair of vertically extending retaining plate insertion slots 15 are formed.

Legs 21 of retaining plate 20 are inserted into the retaining plate insertion slots 15. The retaining plate 20 is metal formed

into a U-shape and includes legs 21, which have U-shaped slots 22. Further, outwardly-directed resilient projections 23 are formed in legs 21.

To mount the optical fiber cable 5 to the plug connector 1, first, a retaining plate 20 is removed from a carrier 25, as shown in Figure 4A. Then, as shown in Figure 3A, the legs 21 of retaining plate 20 are inserted into the plate insertion slots 15, such that the lower ends of both legs 21 do not reach section 13a, with the result that the retaining plate is retained therein by the engagement between the resilient projections 23 and the walls of plate insertion slots 15. Next, as Figures 3A and 4B show, the optical fiber cable 5 having a partly exposed portion of the core 5b at the end portion thereof is inserted into bore 13. At this stage the end portion of jacket 5a is inserted inside section 13a, and the exposed core 5b is inserted into the front section 13b as shown in Figure 3B. The core 5b is disposed in section 13b and projects slightly forward from the front end face 10b.

The retaining plate 20 is then pushed down as shown in Figures 3C and 4C. Since retaining plate 20 is made of thin sheet metal, the edges of U-shaped slots 22 are pressed into the jacket 5a of the optical fiber cable 5. At this stage, the projections 23 of the retaining plate 20 dig into the walls of slots 15 and is retained therein thereby securing retaining plate 20 in position in connector body 10 with the edges of U-shaped slots 22 pressed into or penetrating the jacket 5a which secures cable 5 in position in bore 13 of connector body 10.

Further, since the width of the U-shaped slots 22 is smaller than the diameter of jacket 5a, the edges thereof press into or penetrate the jacket 5a; however, since slots 22 are larger than the diameter of the fiber optic core 5b, retaining plate 20 does not come into contact with the core 5b and create a compressive force thereof. Next, the core 5b, which projects forward from the cylindrical portion 12 is cut off as shown in Figure 3C.

According to the above, the retaining plate 20 firmly retains optical fiber cable 5 in the connector body 10 by the edges of U-shaped slots 22 pressing into or penetrating the jacket 5. In this case, since the retaining plate 20 performs no clamping onto core 5b, the problem of loss of transmission of the light signal by compressing the core does not arise, and a firm retention of the optical fiber cable 5 in the connector is effected.

The optical connector 6 shown in Figure 5 is an example of employing two retaining plates 60 instead of employing the folded type retaining plate 20 in the case mentioned above. The same type of connector body 10 as shown in Figures 1 to 4 is used, and is constructed so that each retaining plate 60 is inserted into the respective plate insertion slot 15 to firmly retain the optical fiber cable 5 in the body 10. Figure 6 shows only one of the above-mentioned retaining plates 60 being used so that in optical fiber connector 7, only one plate insertion slot 71 is formed in the body 70. Thus, the optical fiber cable 5, when inserted in bore 13, is firmly retained in the body 70 by using a single retaining plate 60.

Figure 7 shows an optical fiber connector 8 of the type in which plug and receptacle connectors shown in Figure 1 are formed as one connector.

In this embodiment, a bore 81 extends from the rear face to the front face of the body 80, and the photoelectronic element 83 is mounted in rear section 86 of bore 81. Further, a plate insertion slot 82, which extends from the upper face of the body 80 to bore 81 is also formed, and after inserting the optical fiber cable 5 into bore 81, retaining plate 85 is inserted into plate insertion slot 82 and firmly retains the optical fiber cable by the edges of slot 86 of retaining plate 85 pressing into or penetrating the jacket 5a of the optical fiber cable 5.

Further, the end face of the optical fiber cable 5, when secured in bore 81, is located adjacent or in contact with the photoelectronic element 83 so that the light signal is transferred

between the optical fiber core and the photoelectronic element. Accordingly, Figure 8 shows the optical fiber cable 5 firmly retained in the connector body 80. The retaining plate 85 used here is almost the same as the retaining plate 60 used for the connector in Figure 6 except retaining plate 85 has barbs 87 for digging into the outer walls of slot 82 to secure plate 85 in body 80.

Figures 9 and 10 also show an embodiment of this invention which is a splice connector 9 that connects two optical fiber cables 5 together. In the connector body 90, a bore 91 extends through from one end to the other end thereof. Further, at two places near the ends at the upper face of body 90, plate insertion slots 92,93 are formed and they extend to the bore 91 from the upper face. The optical fiber cables 5 are inserted into bore 91 and the end faces of optical fiber cables 5 are brought close to or into contact with each other at the center of bore 91. At this stage, the retaining plates 95 are inserted into the respective plate insertion slots 92,93, and the slot of each plate 95 presses into or penetrates the jacket of each optical fiber cable 5 and thus firmly retains the pair of optical fiber cables 5 in the body 90 where the end faces of the fiber cores are brought close to or into contact with each other. Retaining plates 95 are also secured in position in slots 92,93 in the same manner as that of plate 85.

Since the optical connectors shown in Figures 7 to 10 require only one component, compared with the former requirement for two components which include the plug connector and the receptacle connector, the cost can be reduced since the number of components has been reduced, and further, the connecting operation of the optical fiber cable is simplified.

As explained above, according to this invention, since the optical fiber cable is firmly retained in the connector body by causing the retaining plate to press into or penetrate the jacket of the optical fiber cable when it is inserted in the connector body, a firm retention of the optical fiber cable is ensured, and

further, the core is not deformed by a compression force created by the retaining plate.

Further, according to this invention, a connection between the optical fiber cable and the photoelectronic element is established by mounting the photoelectronic element directly to the connector body, and a connection between optical fiber cables is established by inserting the optical fiber cables into the connector body and the opposing end faces of both optical fiber cables are in engagement. This connection is then maintained because the optical fiber cables are firmly retained in the connector body by a retaining plate secured in the connector body which is pressed into or penetrates the jacket of the optical fiber cable. These connectors not only have an advantage of a firm retention of the optical fiber cables and a prevention of compressive deformation of the cores, but also enables the plug and receptacle to be one piece. Therefore, the cost of manufacturing is reduced since the number of components is reduced, and further, the connecting operation of the optical fiber cables in relation to the photoelectronic elements is simplified.

Figure 11 is a perspective view of a still further embodiment of the invention showing a hybrid optical-electrical connector 110 and the mating connector 130 to which the connector 110 is to be mated. One end of two optical fiber cables 101 for transmitting and receiving light signals and one end of wires 102, which provide electrical power to the device to which the other end of optical fiber cables 101 are connected, are connected to the hybrid optical-electrical connector 110. Connector 130 is mounted on a P.C. board 104 and has a light-emitting element 131 to transmit light signals and a photosensitive element 132 to receive light signals secured thereto.

The connector 110 comprises a connector housing 111, a contact and retaining plate 113 made of a conductive material, and a detachable cover plate 112 which is fitted as a cover into

an aperture 111e of the connector housing 111. As shown in Figure 12, the connector housing 111 has a cable insertion bore 111a wherein an end of the entire optical fiber cable 101 is inserted, and a core insertion bore 111b which is in communication with cable insertion bore 111a in which the core 101a of the optical fiber cable 101 is inserted. This cable core 101a is arranged to match a front end face of a cylindrical portion 111c of the connector housing 111. Namely, this cylindrical portion 111c acts as a ferrule for the optical connector.

Further, although not shown in Figure 12, the connector housing 111 is also formed with a wire insertion bore, and a wire 102 is inserted in the connector housing 111 along this wire insertion bore. Moreover, at the upper portion of the connector housing 111, a cavity 111d, which opens toward the front thereof, is formed. Further, in the upper wall of housing 111, a contact plate insertion aperture 111e is formed. Note, this contact plate insertion aperture 111e is used when the plate 113 is inserted from above, and receives a detachable cover plate 112 after the plate 113 is inserted therein, as shown in Figures 11 and 12.

When the contact and retaining plate 113 is inserted into the connector housing 111 through the contact plate insertion aperture 111e and retained inside the housing 111, it is engaged with the respective optical fiber cable 101 and wire 102, and thus retains the cable 101 and the wire 102 in the housing 111.

An explanation of the engagement of this contact and retaining plate 113 with the cable 101 and the wire 102, with reference to Figures 13A and 13B, is described as follows. Figures 13A and 13B are perspective views showing the end portions of the optical fiber cable 101 and the wire 102 that are to be inserted in the connector housing 111, the core 101a being exposed by stripping the jacket 101b at the end portion of the optical fiber cable 101, and the wire 102 having the conductor still insulated.

The contact and retaining plate 113 is made from a sheet of conductive material, such as metal, and folded into a U-shape. Both leg portions of plate 113 are respectively formed with a slot 113a for the optical fiber cable 101 and a slot 113b for the wire 102. Therefore, when the contact plate 113 is inserted into housing 111 with the leg portions extending into slots 111f of housing 111, the optical fiber cable 101 and the wire 102 enter the slots 113a,113b respectively. The width of the slot 113a is smaller than the outer diameter of the jacket 101b of the cable 101 and larger than the diameter of the core 101a thereof, and thus the edges of slot 113a is pressed into and penetrates the jacket 101b and is engaged with the cable 101. Similarly, for the wire 102, the edges of slot 113b is pressed into and penetrates the insulation of wire 102 and is engaged with the wire 102. In this case, the edges of slot 113b are connected with the conductor of the wire, and thus the wire 102 and the contact plate 113 are electrically connected. Plates 113 are secured in housing 111 in the same manner as plates 20,60,85 and 95.

The cross-sectional views of Figures 14 and 15 show the hybrid optical-electrical connector 110 connected with the connector 130. The connector 130 is composed of the housing 133, having an electrical contact 134, light-emitting element 131, and photosensitive element 132 (only the light-emitting element 131 is shown in Figures 14 and 15) arranged in housing 133. Connector 130 is mounted to the P.C. board, and the light-emitting element 131, the photosensitive element 132, and the contact 134 are connected with the circuitry on the P.C. board. Further, although the contact 134 should not appear in the cross-section shown in Figure 14, it is shown to illustrate the way in which the contact provides power to the P.C. board. The connector housing 133 has an opening 133a for receiving hybrid optical-electrical connector 110, and when the connector 110 is inserted in opening 133a, as shown in Figure 14, then the connection of both connectors 110 and 130 is completed. Thus,

the front end face of the cylindrical portion 111c of the connector 110 is brought adjacent and opposite the light-emitting element 131 or the photosensitive element 132, and accordingly, the end face of the core 101a is opposed to the element 131 or 132, thereby allowing transfer of the light signals. Moreover, the end of the contact 134 enters the cavity 111d of the connector housing 111 and is connected with an upper face of the contact plate 113, therefore, the contact 134 and the contact plate 113 are electrically connected, and thus the electric power is also transferable. Accordingly, by using the hybrid optical-electrical connector of this invention, the transfer of both the light signals and the electric power can be conducted by a connector having a simplified structure.

Figure 16 is a perspective view showing a further embodiment of the hybrid optical-electrical connector of this invention. In this embodiment, in the hybrid optical-electrical connector 140, the wires 102 and the optical fiber cables 101 are arranged in two rows and are inserted and retained at the upper portion and the lower portion of connector housing 141 respectively, by means of contact and retaining plates 142 which are inserted into slots 141a from each side of the connector housing 141. Note, since the engagement of the contact and retaining plates 142 with optical fiber cables 101 and wires 102 is the same as above, an explanation thereof is omitted. Accordingly, in the matable connector 150 to which connector 140 is connected, contacts 154 are arranged at both sides thereof along a cavity in which connector 140 is received, thus contacts 154 are connected with the contact and retaining plates 142 at each side, as shown in Figure 17. At the same time, an end of the optical fiber core 101a of the optical fiber cable 101 is positioned opposite the light-emitting element 151 or the photosensitive element 152 enabling transfer of light signals.

Figure 18 shows a connector in which a connection is made between two ends of optical fiber cables 101. Hybrid optical-electrical connectors 110 of Figures 11-15 are connected

to the end portions of two cables 101 and wires 102 respectively and then are interconnected by a connector 160. Connector 160 includes a housing 161 having cavities 161a at both ends thereof to receive the hybrid optical-electrical connectors 110, and a contact 162 secured inside housing 161 with both ends thereof projecting inside each cavity 161a. The housing 161 also has a hole 161b formed therein that extends between both cavities 161a.

The connectors 110 are inserted in respective cavities 161a, and thus each end of contact 162 is connected with contact plates 113 of the connectors 110. Therefore, the electrical connection of the wires 102 of the connectors 110 is completed through the contact 162. At the same time, the cylindrical portions 111c of the connectors 110 enter hole 161b, and therefore, the ends of cylindrical portions 111c are positioned opposite each other, thereby enabling a transfer of light signals between the optical fiber cables 101.

The above explanation of Figures 11-18 is directed to optical fiber cables and wires in the hybrid optical-electrical connectors that are separately secured in parallel in the connector housing; however, in the optical-electrical hybrid connection shown in Figures 19A and 19B, the cable 103 comprises a cable in which the optical fiber core 103d is insulated by sleeve 103c and surrounded by a plurality of conductors 103b, then covered with an insulation jacket 103a. Cable 103 not only enables the transmission of both light signals and electrical power by a single cable line, but also has an advantage of an increased strength of the cable 103 which is provided by the conductors 103b.

As shown in Figure 21, in the hybrid optical-electrical connector 170, the cable 103 is retained in the connector housing 171 by engagement with contact and retaining plate 173 when the end portion thereof is inserted in the connector housing 171, and the basic structure is similar to the hybrid optical-

electrical connector 110 shown in Figure 11. Therefore, an explanation will be omitted since the structure of the matable connector 180 and the method of connection with connector 180 are the same as that of Figure 11. However, as shown in Figures 19A to 20B, the engagement of the contact and retaining plate 173 with the cable 103 is different in that the edges of slots 173a of the contact plate 173 are pressed into and penetrates the outer insulation 103 of the cable 103, so that the contact plate 173 is electrically connected with the conductors 103b of the optical fiber cable 103.

Next, Figure 22 shows a system which conducts a transfer of information by light signals by using the hybrid optical-electrical connectors of Figures 11-15. In this system the contact between the transmitting device 105 and the receiving device 105' is maintained with the optical fiber cable 101. In this system, a power supply 107 is provided only at the transmitting device 105, and therefore, the wire 102 for supplying operating power to the stabilizing circuit 108, the photosensitive element 132, and the electronic circuit 9 at the device 105' is arranged in parallel with the optical fiber cable 101. The connection of the ends of the optical fiber cable 101 and wire 102 with the transmitting device 105 and receiving device 105' is conducted by the above-mentioned hybrid optical-electrical connectors 110, 110' of this invention. The transmitting device 105 comprises a light-emitting element 131 which is positioned adjacent the front end face of the optical cable 101 in the hybrid optical-electrical connector 110, an electronic circuit 106 which transmits the electrical signal to this light-emitting element 131 to generate a specified light signal, and a power supply 107 for supplying operating power to the electronic circuit 106 and element 131. Therefore, an electric signal is emitted from the electronic circuit 106 to the light-emitting element 131, and then a light signal specified by this emission is transmitted by the light-emitting element 131 to the optical fiber cable 101. Further, the power supply 107 is

connected to a contact plate inside the hybrid optical-electrical connector 110, and thus power is sent to the wire 102 through this contact plate.

On the other hand, the receiving device 105' comprises a photosensitive element 132, a stabilizing circuit 108, and an electronic circuit 109. The stabilizing circuit 108 stabilizes the power transmitted from the power supply 107 through the wire 102 to operate the photosensitive element 132 and the electronic circuit 109. The photosensitive element 132 and the electronic circuit 109 are operated by receiving power from circuit 108. The photosensitive element 132 is positioned adjacent to the front end face of the optical cable 101 in the hybrid optical-electrical connector 110', and is used for a photoelectronic transfer of the light signal transmitted through the optical fiber cable 101. The electric power is transferred as described above is utilized by electronic circuit 109.

According to this invention, in the hybrid optical-electrical connector the end portions of the optical fiber cable and the wire are inserted in the connector housing and retained therein by engagement with the contact and retaining plate which is fitted inside the connector housing, and at the same time, the contact plate is connected with the conductor of the wire, and the transfer of the light signal is conducted by positioning the end face of the optical fiber cable core adjacent to a photoelectronic element, and further, the transfer of the electric power is conducted by connecting the contact and retaining plate with an electric contact when this hybrid optical-electrical connector is connected with a matable connector, therefore, both the light signals and electric power can be transferred by a single connector. Accordingly, the structure and assembly is simplified and the size of the hybrid optical-electrical connector is reduced, and the manufacturing cost is also reduced.

CLAIMS:

1. An optical fiber connector for connection to an optical fiber cable (5,101,103) having an optical fiber core (5b,101a,103d) and an outer jacket (5a, 101b,103a), the connector comprising a housing (10,70,80,90,111,141,171) including a bore (13,81,111a) in which an end of the optical fiber cable is to be positioned, and a retaining member (20,60,85,95,113,142,173) retaining the end of the optical fiber cable in the bore, characterized in that:

said housing has at least one slot (15,71,82,92,93,111f,141a) in communication with said bore;

said retaining member being pressed into said housing slot and having a slot (22,86,113a,173a) which is of less width than the diameter of the optical fiber cable but is of greater width than the optical fiber core so that the edges of the slot press into the jacket retaining the optical fiber cable in the connector without damage to the optical fiber core.

2. An optical fiber connector as claimed in claim 1, characterized in that the retaining member has securing members (23,85) for securing the retaining member in the housing slot.

3. An optical fiber connector as claimed in claim 1, characterized in that the housing has a cylindrical section (12,111c) having a bore (13b,111b) of reduced diameter in which an exposed end of the optical fiber core (5b,101a) is positioned.

4. An optical fiber connector as claimed in claim 1, characterized in that said bore has a photoelectronic member (83) positioned therein.

5. An optical fiber connector as claimed in claim 1, characterized in that said retaining member (20,113,142,173) is U-shaped.

6. An electrical connector as claimed in claim 1, characterized in that said retaining member (60,85,95) is a planar member.

7. An electrical connector as claimed in claim 1, characterized in that electrical wires (102,103b) are positioned

in said housing and said retaining member (113,142,173) has a slot (113b,173a) for electrical engagement with the electrical wires.

8. An electrical connector as claimed in claim 7, characterized in that a matable connector (130,150,160,180) includes an electrical contact (134,154) that electrically engages said retaining member (113,142,173) when the optical fiber connector (110,140,180) mates with the matable connector (130,150,160,180).

9. An electrical connector as claimed in claim 8, characterized in that the electrical wires (103b) are part of the fiber optic cable (103).

10. An electrical connector as claimed in claim 8, characterized in that photoelectronic members (131,132,151,152) are mounted in the matable connector.

FIG. 1

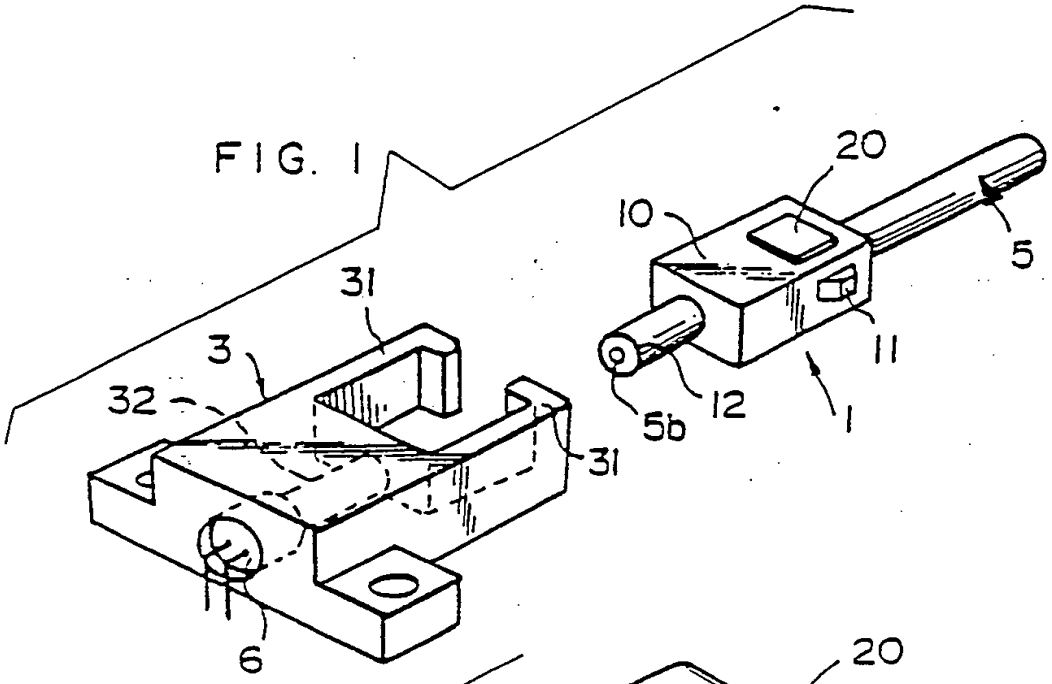

20
10
5
31
3
11
32
12
5b
1
31
6

FIG. 2

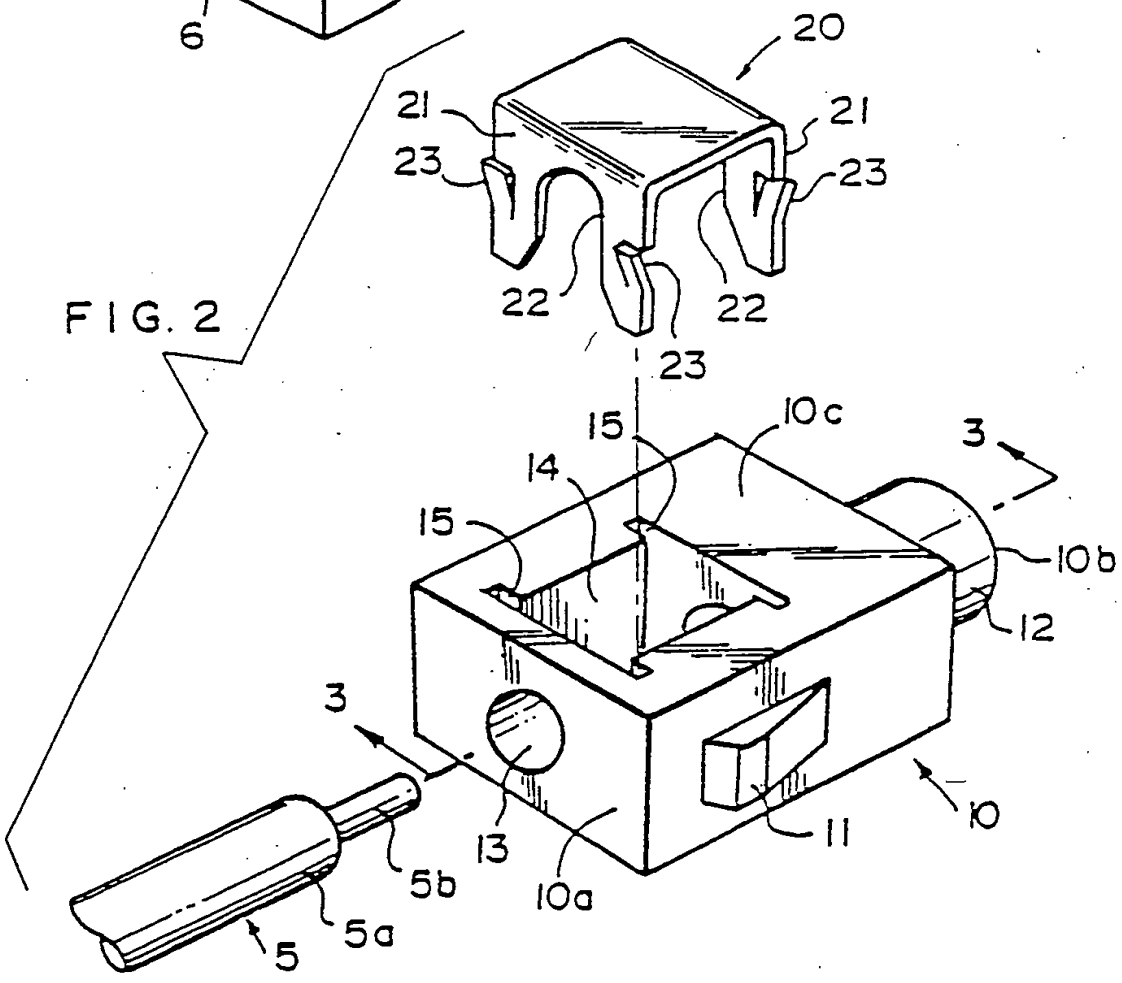

20
21
21
23
23
22
22
23
15
10c
3
14
15
10b
12
3
13
10
11
10a
5b
5a
5

FIG. 3A

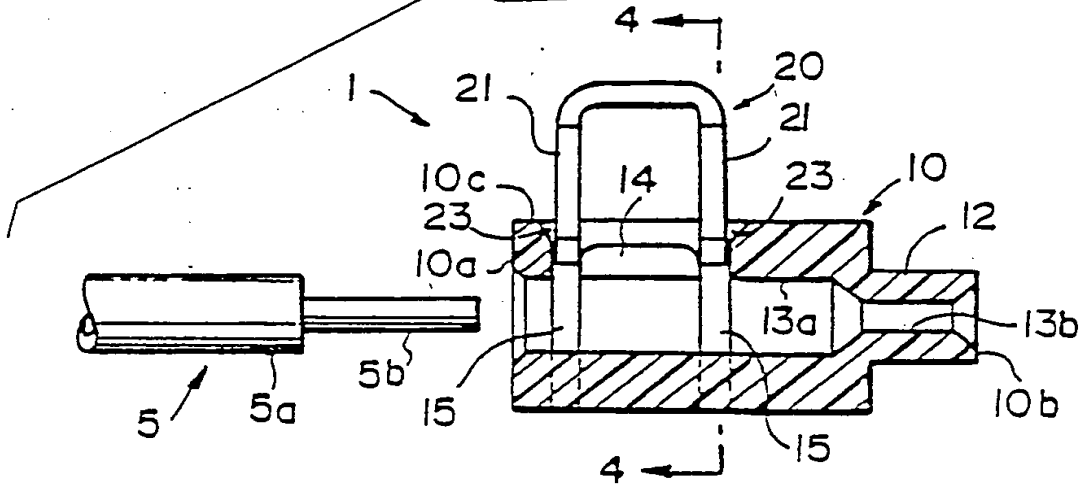


FIG. 3B

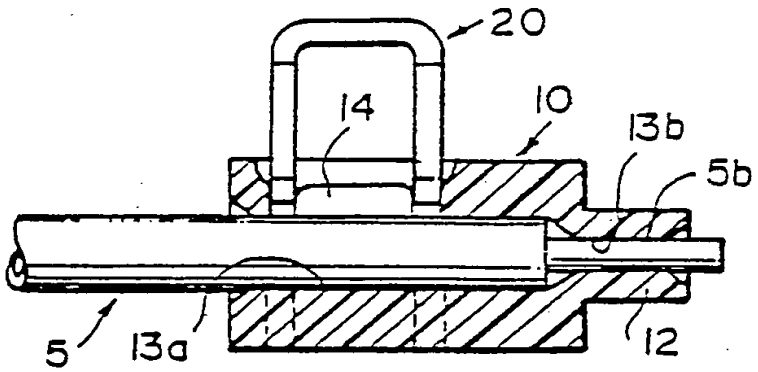


FIG. 3C

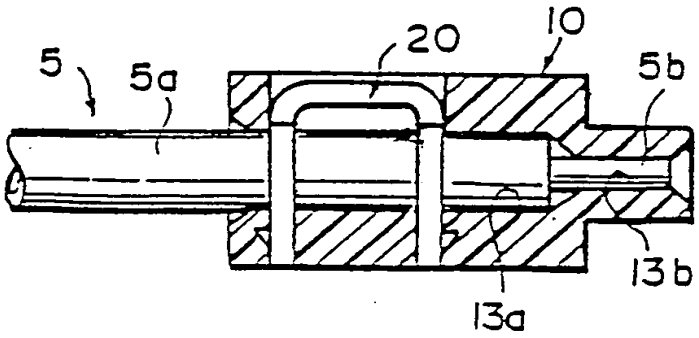


FIG. 4A

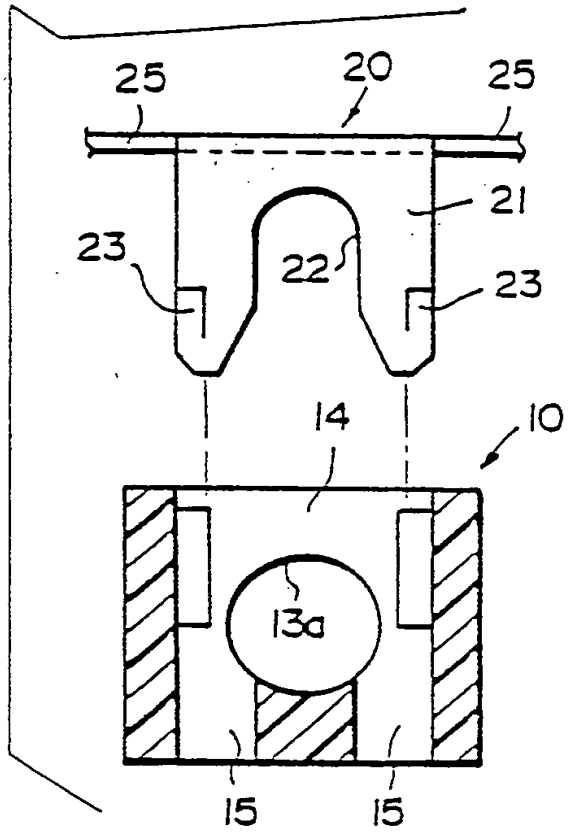


FIG. 4B

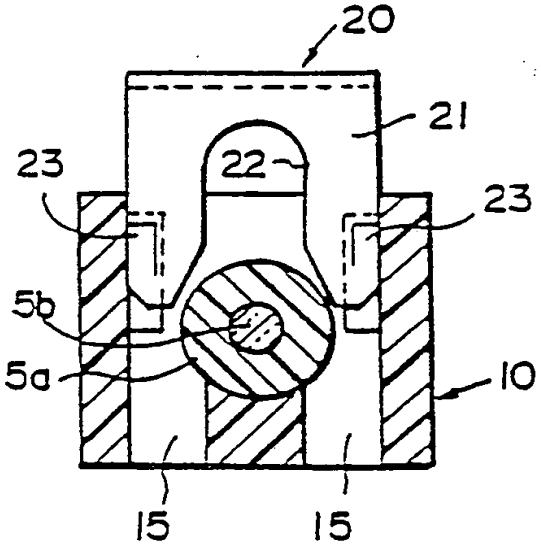


FIG. 4C

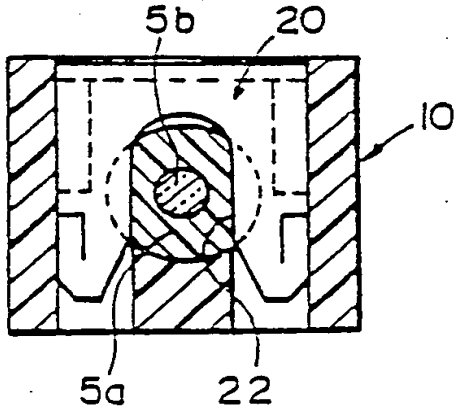


FIG. 5

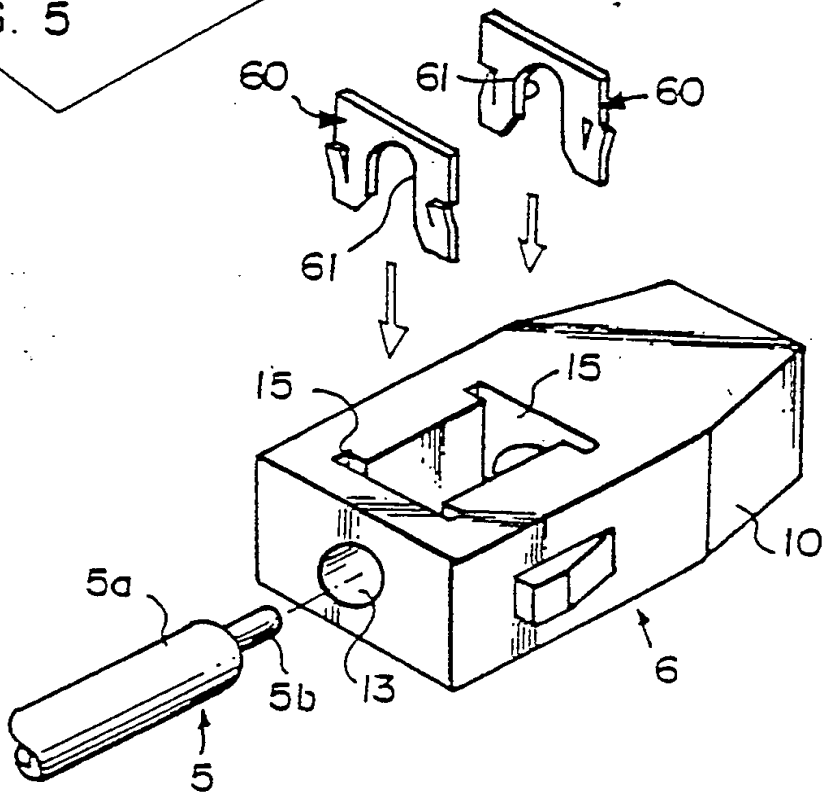


FIG. 6

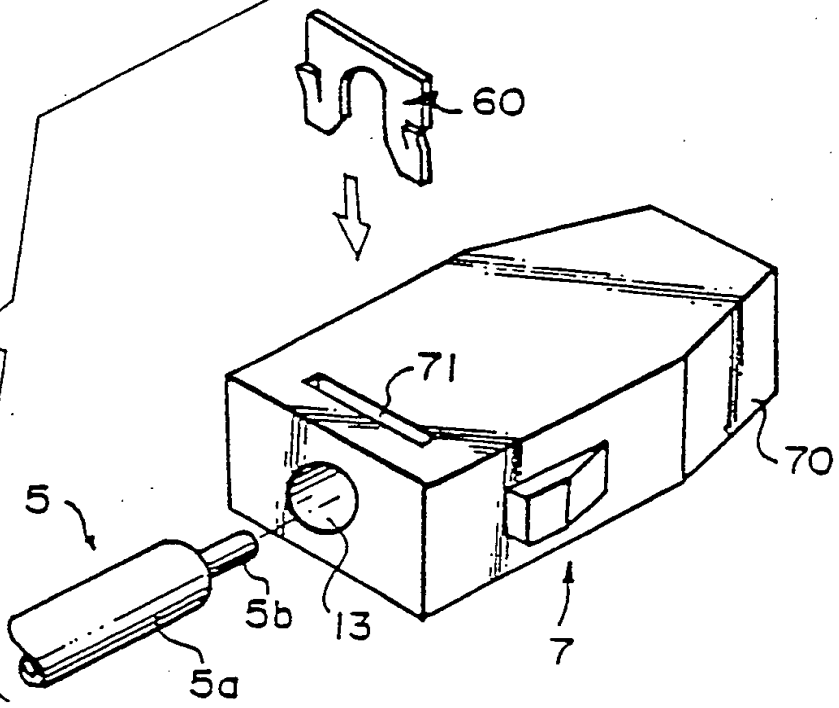


FIG. 7

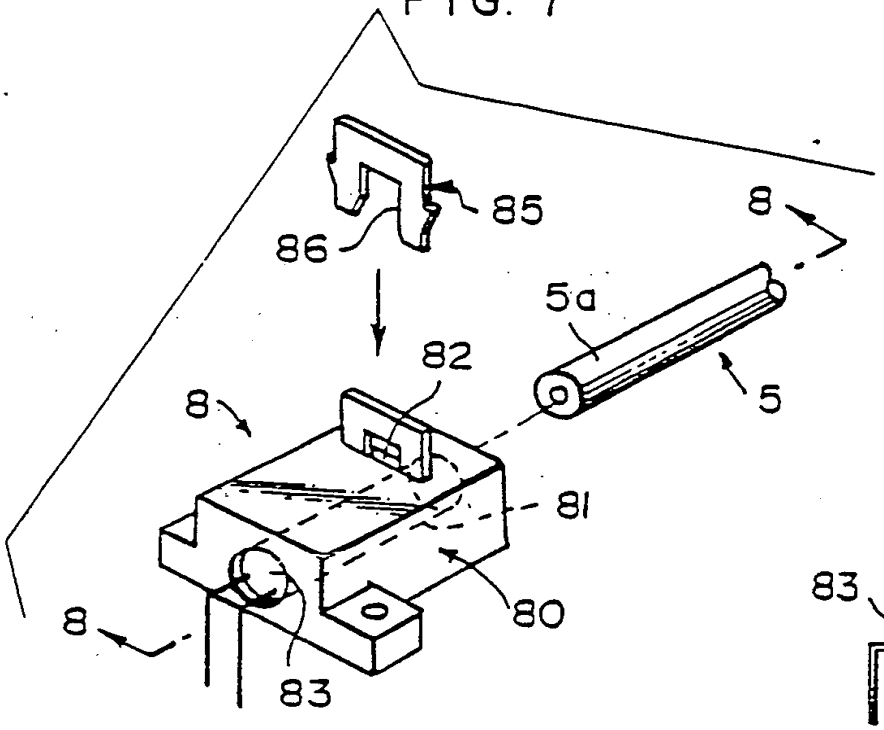


FIG. 8

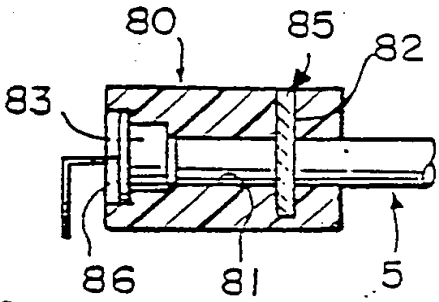


FIG. 9

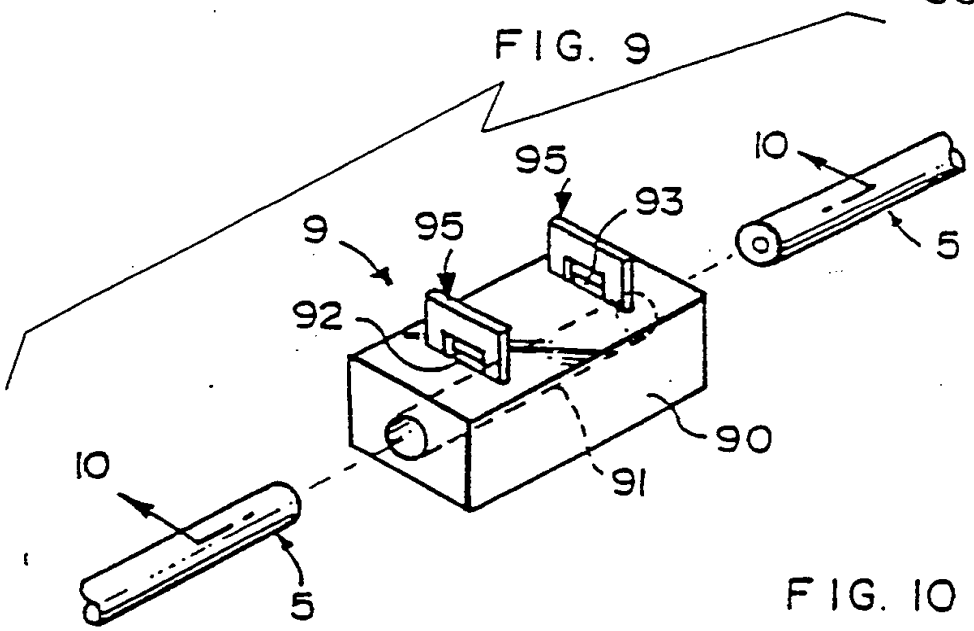


FIG. 10

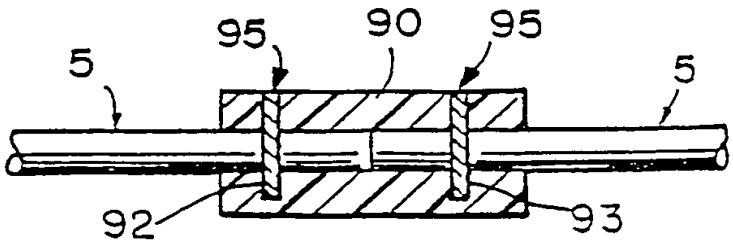


FIG. 11

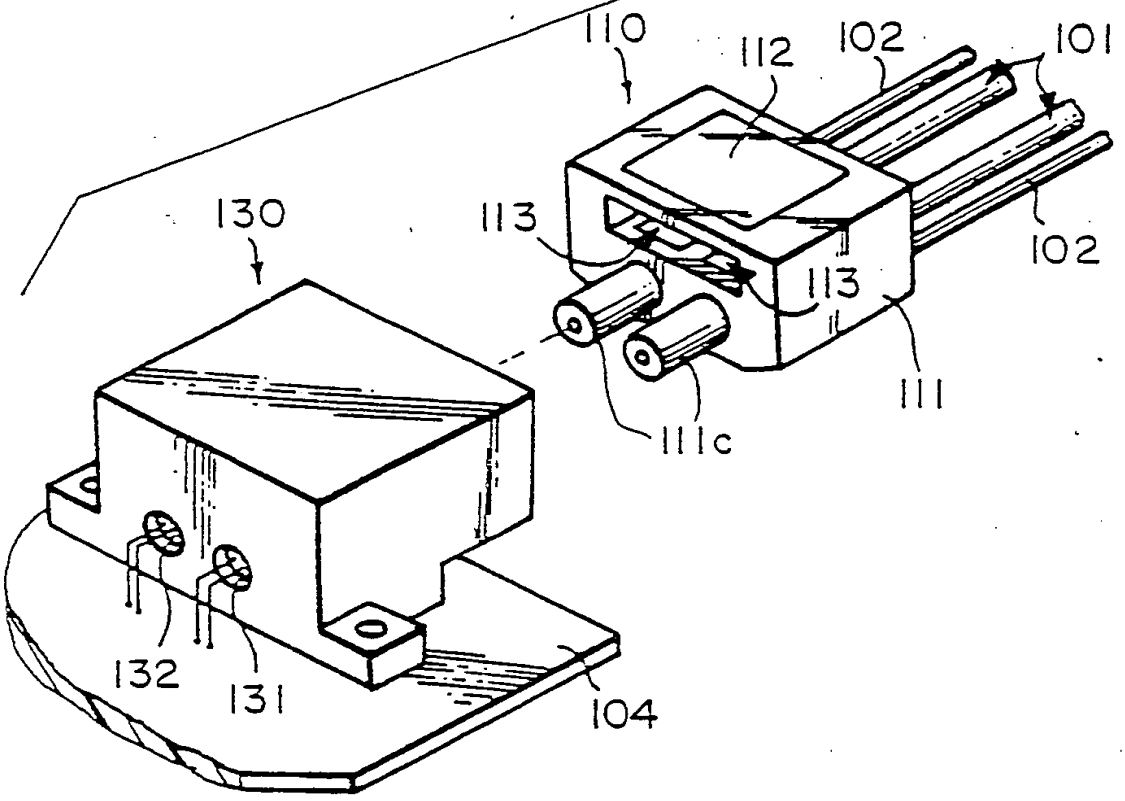
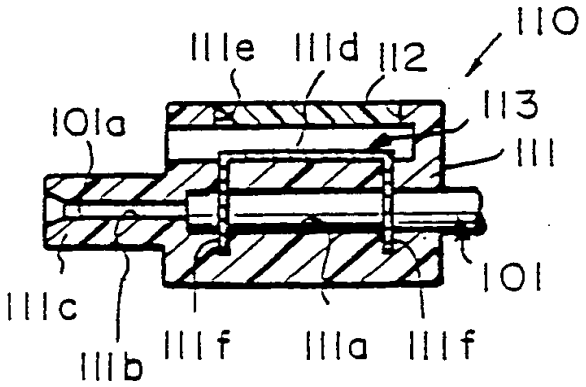

110
112
102
101
130
113
113
102
111
111c
132
131
104

FIG. 12


110
111e
111d
112
113
101a
111
101
111c
111b
111f
111a
111f

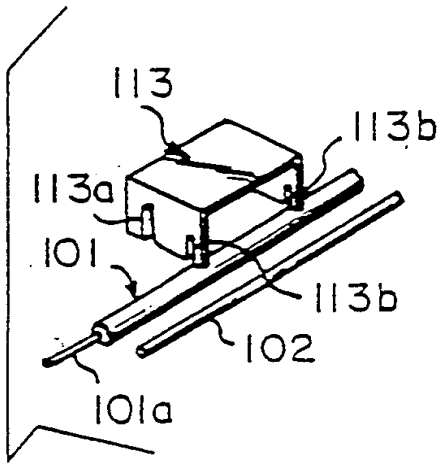


FIG.13A

FIG.13B

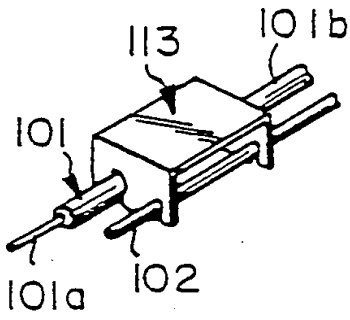


FIG.14

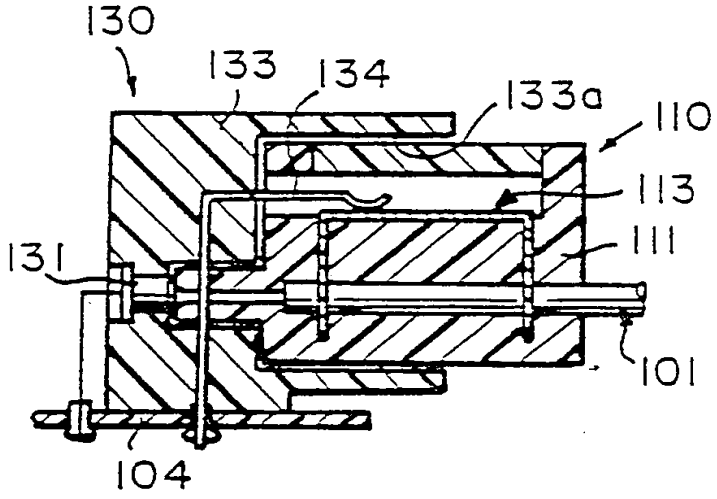


FIG.15

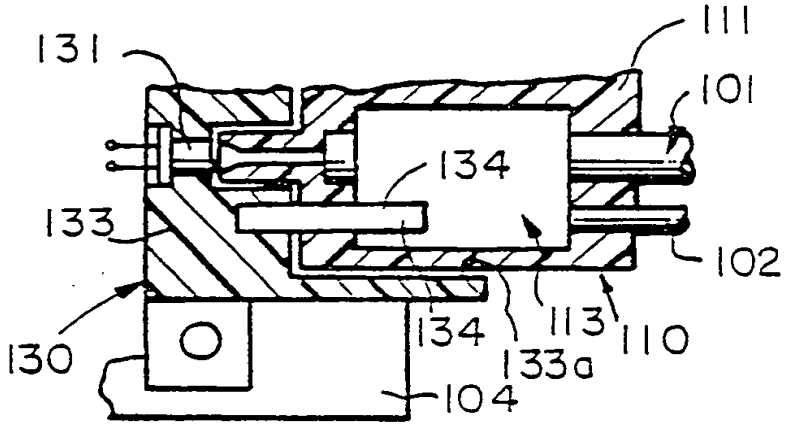


FIG.16

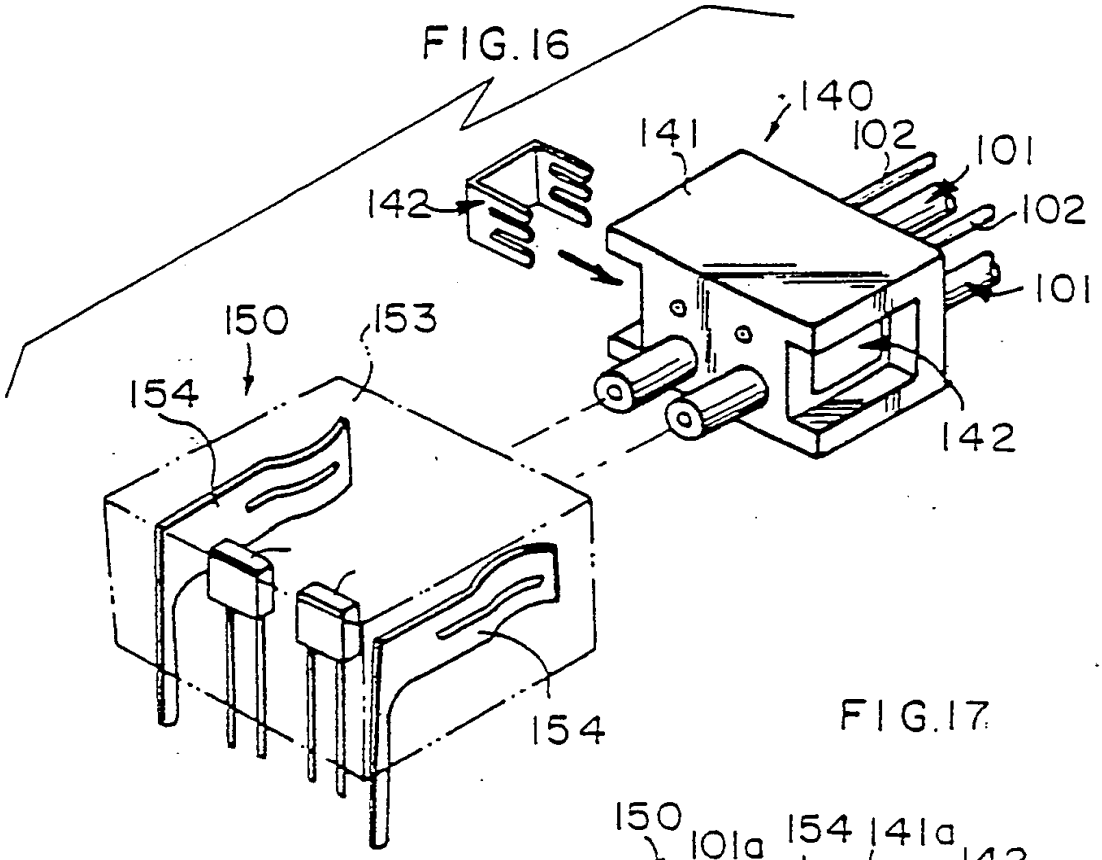


FIG.17

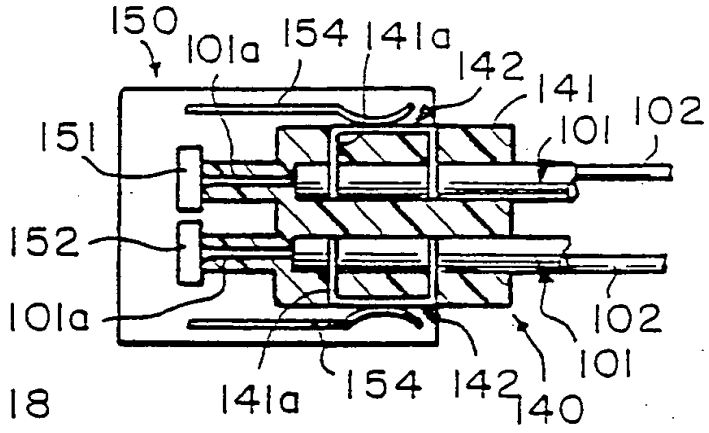


FIG.18

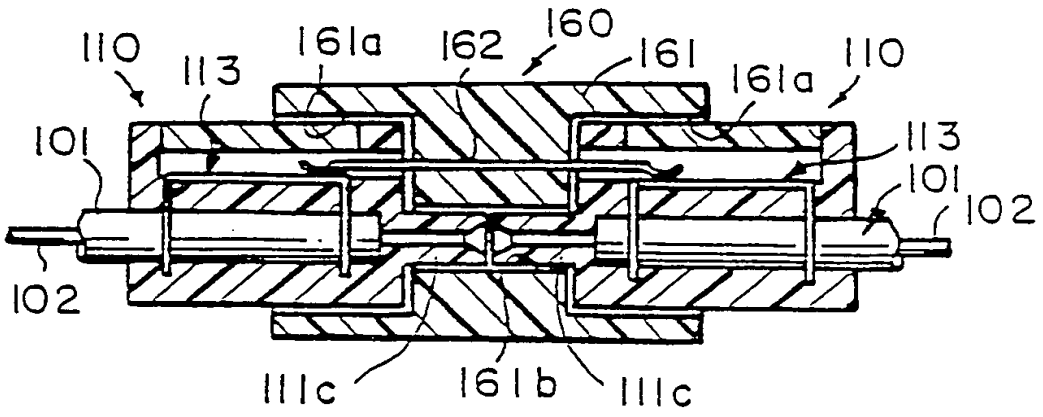


FIG.19A

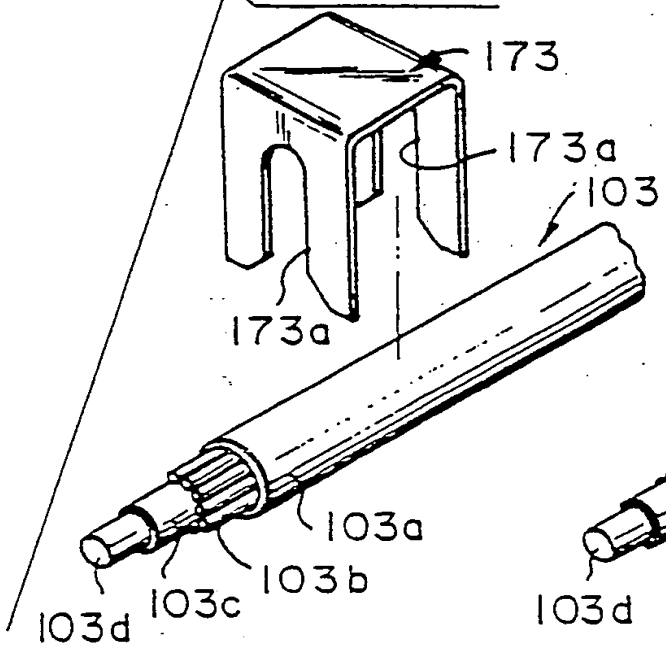


FIG.19b

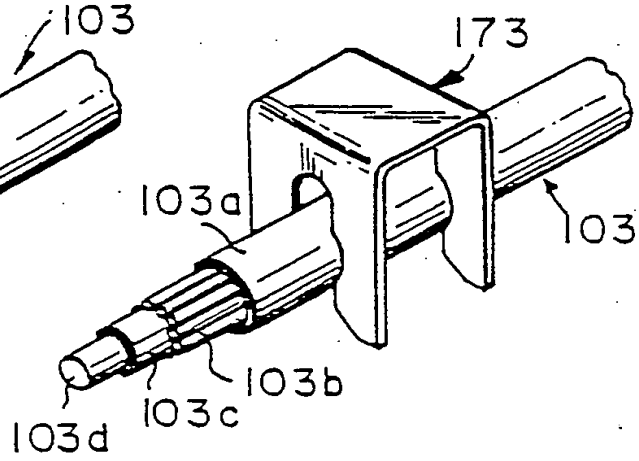


FIG.20

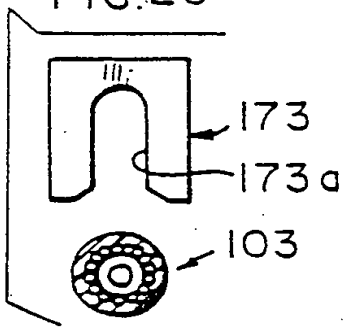
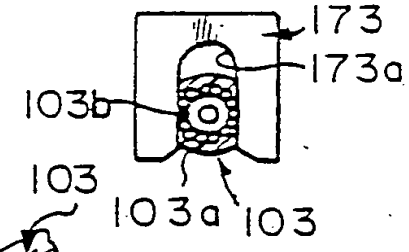


FIG.20B



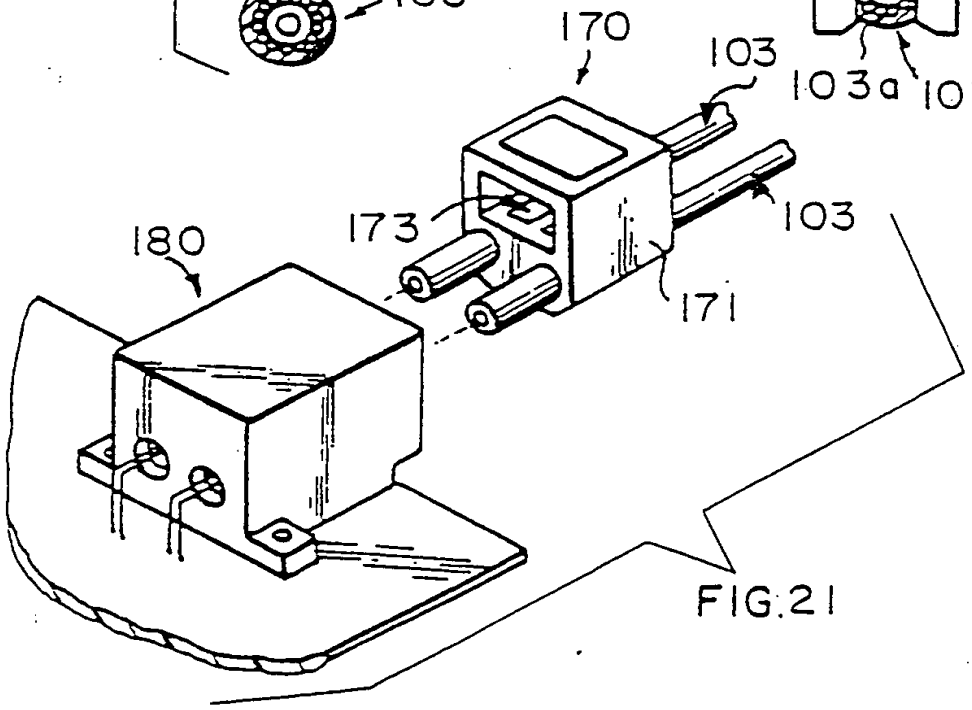


FIG.21

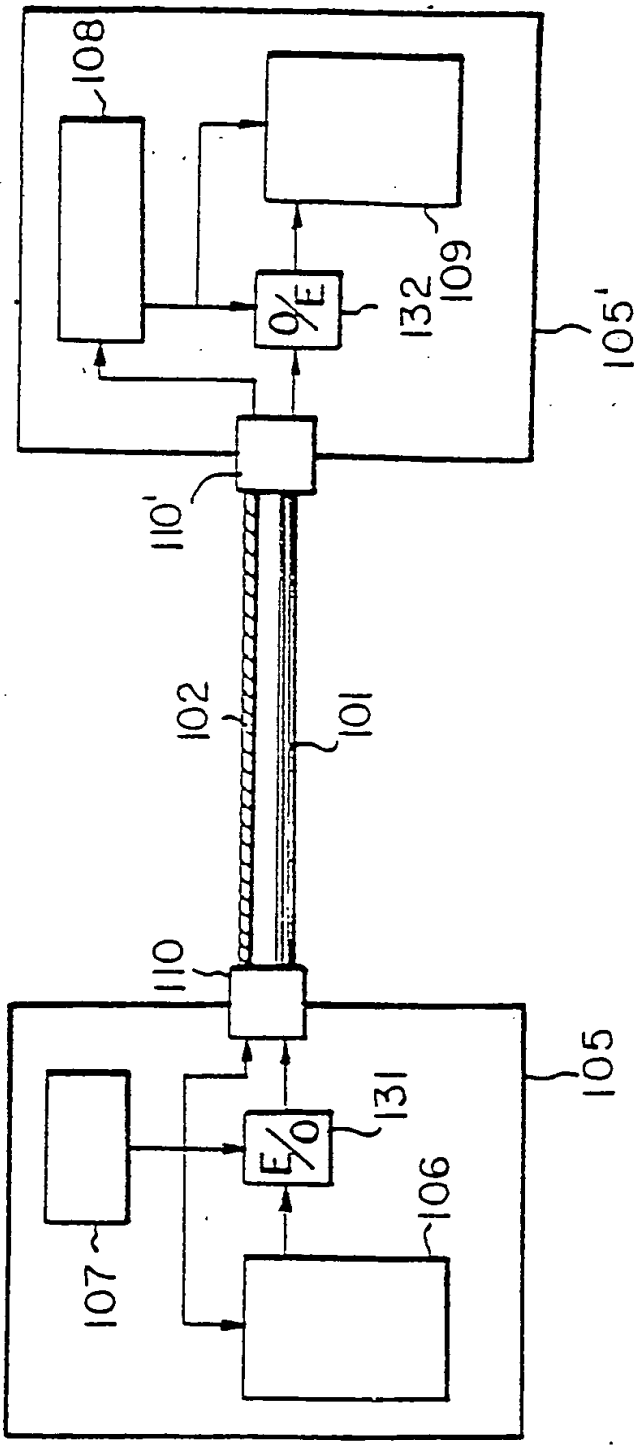


FIG.22

INTERNATIONAL SEARCH REPORT

International Application No PCT/US86/02748

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

INT. CL.[4] G02B 6/38, 6/42
U.S. CL. 350/96.2

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	350/96.2, 96.21, 96.22 250/227, 552 357/17, 19, 30, 74

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	US, A, 4,081,208 (MEADE) 28 March 1978 See column 1, line 63 to column 2, line 36.	4, 7-10
Y	US, A, 4,134,641 (KAO ET AL) 16 January 1979 See column 2, lines 44-61 and column 4, lines 48-50.	1-10
A	US, A, 4,327,964 (HAESLY ET AL) 04 May 1982 See the entire document.	1-6
A	US, A, 4,439,006 (STEVENSON) 27 March 1984 See figures 1 and 6.	1-6
A	US, A, ,479,696 (LUBIN ET AL) 30 October 19 See figure 3 and column 2, lines 38-65.	1-6
A	US, A, 4,547,039 (CARON ET AL) 15 October 1985 See the entire document.	1-6
Y,E	US, A, 4,645,295 (PRONOVOST) 24 February 1987 See column 6, line 52 to column 7, line 8.	1-10

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
28 May 1987	22 JUN 1987
International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	John D. Lee

Form PCT/ISA/210 (second sheet) (May 1986)